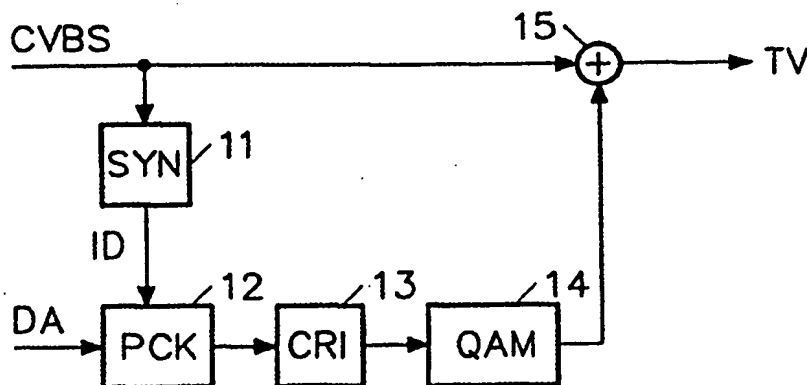




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : <b>H04N 7/081, 7/088</b>	<b>A1</b>	(11) International Publication Number: <b>WO 00/35195</b> (43) International Publication Date: <b>15 June 2000 (15.06.00)</b>
<p>(21) International Application Number: <b>PCT/EP99/09204</b></p> <p>(22) International Filing Date: <b>24 November 1999 (24.11.99)</b></p> <p>(30) Priority Data: <b>98204138.6</b>      <b>8 December 1998 (08.12.98)</b>      <b>EP</b></p> <p>(71) Applicant: <b>KONINKLIJKE PHILIPS ELECTRONICS N.V.</b> [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).</p> <p>(72) Inventor: <b>VAN SPLUNTER, Marinus; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).</b></p> <p>(74) Agent: <b>SCHMITZ, Herman, J., R.; Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).</b></p>		<p>(81) Designated States: <b>AU, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b></p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: DATA TRANSMISSION IN A TELEVISION SIGNAL USING QUADRATURE AMPLITUDE MODULATION



## (57) Abstract

Method and system for transmitting data in lines of a video signal. The data is packetized (12), provided with a clock-run-in sequence (13) and quadrature amplitude-modulated (14), using a carrier ( $f_c$ ) which is located in the middle of the video bandwidth. The modulated data signal is then inserted (15) in selected video lines. In the preferred embodiment, QAM-16 is used so that data can be transmitted in the vertical blanking interval of a television signal at a higher bit rate (approximately 16 Mbit/s) than conventional teletext (6.9 Mb/s). Optionally, QAM-64 or even QAM-256 may be used to obtain a bit rate of approximately 24 or 32 Mbit/s, respectively.

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# DATA TRANSMISSION IN A TELEVISION SIGNAL USING QUADRATURE AMPLITUDE MODULATION

## FIELD OF THE INVENTION

The invention relates to a method and an arrangement for transmitting data packets in video lines of a television signal.

## 5 BACKGROUND OF THE INVENTION

A method of transmitting data in video lines of a television signal is generally known as teletext. In known teletext systems, the data is accommodated in a television line in the form of a non-return-to zero (NRZ) signal. The maximum bit rate in such a transmission system is restricted. For example, in PAL television systems having a video bandwidth of  
10 5 MHz the teletext bit rate is approximately 6.9 Mb/s.

## OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to provide a data transmission method with a higher bit rate.

15 To this end, the method is characterized by quadrature amplitude modulating each data packet, using a predetermined carrier frequency which is located within the baseband video bandwidth of said television signal, and inserting said quadrature amplitude-modulated data packet in selected video lines of the television signal which are not used for video signal transmission. Preferably, the carrier frequency is substantially half the baseband  
20 video bandwidth of the television signal.

The corresponding method of receiving data packets comprises the step of quadrature amplitude-demodulating said data packets.

## BRIEF DESCRIPTION OF THE FIGURES

25 Fig. 1 shows schematically an arrangement for transmitting data in accordance with the invention.

Fig. 2 shows a schematic diagram of a quadrature amplitude modulator.

Figs. 3-5 show diagrams to illustrate the operation of the arrangement which is shown in Fig. 1.

Fig. 6 shows schematically an arrangement for receiving data in accordance with the invention.

Fig. 7 shows a schematic diagram of a quadrature amplitude demodulator.

## 5 DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 shows schematically an arrangement for transmitting data in accordance with the invention. The arrangement receives a conventional composite video and blanking signal CVBS and a data signal DA. The transmitter includes a sync processing circuit 11 which identifies the video lines that are used for data transmission. Any line of the video  
10 signal may be used for this purpose. Usually, they are selected lines in the vertical blanking interval. The identification signal ID generated by the sync processing circuit 11 is applied to a packetizing circuit 12 which receives the data DA to be transmitted and creates packets of, for example, 800 data bits at a bit rate of, for example, 16 Mbit/s. The data packet is applied to a clock-run-in inserter 13 which places a predetermined clock-run-in (CRI) bit pattern in front of  
15 the packet. The packet including the CRI is then quadrature amplitude-modulated in a quadrature amplitude modulation (QAM) circuit 14. The modulated data packet is subsequently inserted in the selected video line by an adder 15.

Fig. 2 shows schematically a more detailed diagram of the quadrature amplitude modulator 14 which is here assumed to be a QAM-16 modulator. The modulator comprises a  
20 symbol generator 141 which divides the data packet into successive series of 4 data bits, and creates two 2-bit symbols  $S_i$  and  $S_q$  for each series. Each symbol is represented by a predetermined signal amplitude. More particularly, an amplitude -3 represents data bits "00", an amplitude -1 represents "01", an amplitude +1 represents "10", and an amplitude +3 represents "11". As shown in Fig. 3, there are 16 combinations of symbols  $S_i$  and  $S_q$ . Each  
25  $\{S_i, S_q\}$  pair of symbols in Fig. 3 represents one series of 4 data bits.

The sequences of symbols  $S_i$  and  $S_q$  are subjected to low-pass filters 142 and 143, respectively, preferably square-root Nyquist filters. The filtered sequences are subsequently modulated on respective carriers having a frequency  $f_c$  by respective multipliers  
144 and 145. The carrier frequency is substantially half the video bandwidth, for example,  
30  $f_c=2.5\text{MHz}$ . The symbols  $S_i$  are modulated on an in-phase carrier. The symbols  $S_q$  are modulated on a carrier, the phase of which has been shifted by  $90^\circ$  through a phase shifter 146. The resultant in-phase signal I and quadrature signal Q are added by an adder 147 and processed by a post-processor 148. The post-processor 148 scales the modulated signal and shifts its DC level in such a manner that the output signal complies with the relevant television

standard (PAL or NTSC). The modulator 14 is preferably implemented as a digital processing circuit operating at a 13.5 MHz line-locked frequency. The 2.5 MHz carrier frequency ( $\frac{5}{27} \times 13.5$ ) and the 4 MHz frequency for forming the symbols ( $\frac{8}{27} \times 13.5$ ) can easily be derived from said frequency.

5 Fig. 4 shows a line of the television signal with data. Numeral 41 denotes a data packet with 800 bits of QAM-modulated data, numeral 42 denotes the clock-run-in, numeral 43 denotes the horizontal synchronization pulse. The function of the clock-run-in is to assist a receiver in regenerating the carrier  $f_c$  with sufficient phase accuracy. To achieve this, the clock-run-in is preferably an alternating sequence of diagonal symbol pairs such as the symbol  
10 pairs {3,-3} and {-3,3} (numerals 31 and 32 in Fig. 3). Fig. 5 shows the frequency spectrum 51 of the quadrature-modulated data signal.

Fig. 6 shows schematically an arrangement for receiving data in accordance with the invention. The arrangement receives the television signal and applies it to a quadrature amplitude demodulator 61 and a sync separation circuit 62. Optionally, the signal is  
15 also applied to a conventional television receiver 63. The sync separation circuit 62 identifies the lines in the vertical blanking interval and activates the demodulator 61 during these lines. After demodulation, the data DA are further processed by a data processor 64, for example, a personal computer.

Fig. 7 shows a schematic diagram of the quadrature amplitude demodulator 61.  
20 The demodulator comprises a pre-processor 611 which receives the television signal and the signal ID identifying the vertical blanking interval. The pre-processor removes the DC component and performs automatic gain control.

The pre-processed signal is applied to a clock regeneration circuit 612 and multipliers 613 and 614. The clock regeneration circuit 612 regenerates the carrier frequency  
25  $f_c$  (2.5 MHz) and a sample clock  $f_s$  (4 MHz) in response to the clock-run-in CRI. The multipliers 613 and 614 multiply the QAM data signal by an in-phase component and a quadrature phase component of the regenerated carrier  $f_c$ , respectively. The latter component is obtained by means of a 90° phase shift of the regenerated carrier in phase shifter 615. The symbols  $S_i$  and  $S_q$  are reconstructed by low-pass filtering the multiplied signals using square-  
30 root Nyquist filters 616 and 617. Analog-to-digital converters 618 and 619 convert the symbols back into the original data bits DA. The demodulator 61 is preferably implemented as a digital processing circuit operating at a 13.5 MHz line-locked frequency.

With the QAM-16 modulation system described above, the bit rate of 16 Mbit/s is approximately 2.3 times the bit rate of a conventional teletext system. In cable systems having a good signal-to-noise ratio, it is also possible to use QAM-64, in which the input data at a bit rate of 24 Mbit/sec (3.5 times the conventional bit rate) is divided into series of 6 bits, or even QAM-256 in which the input data at a bit rate of 32 Mbit/sec (4.6 times the conventional bit rate) is divided into series of 8 bits.

In summary, a method and a system for transmitting data in lines of a video signal are disclosed. The data is packetized (12), provided with a clock-run-in sequence (13) and quadrature amplitude-modulated (14), using a carrier ( $f_c$ ) which is located in the middle of the video bandwidth. The modulated data signal is then inserted (15) in selected video lines. In the preferred embodiment, QAM-16 is used so that data can be transmitted in the vertical blanking interval of a television signal at a higher bit rate (approximately 16 Mbit/s) than conventional teletext (6.9 Mb/s). Optionally, QAM-64 or even QAM-256 may be used to obtain a bit rate of approximately 24 or 32 Mbit/s, respectively.

## CLAIMS:

1. A method of transmitting data packets in video lines of a television signal, characterized by quadrature amplitude-modulating (14) each data packet, using a predetermined carrier frequency ( $f_c$ ) which is located within the baseband video bandwidth of said television signal, and inserting (15) said quadrature amplitude-modulated data packet in  
5 selected video lines of the television signal which are not used for video signal transmission.
2. A method as claimed in claim 1, wherein said carrier frequency is substantially half the baseband video bandwidth of the television signal.
- 10 3. A method as claimed in claim 1, wherein each data packet includes a clock-run-in sequence formed by an alternating sequence of diagonal symbols (31,32) in the (I,Q) space of the modulated signal.
4. A method as claimed in claim 1, wherein said video line is a line of the vertical  
15 blanking interval of the television signal.
5. A method as claimed in claim 1, wherein said quadrature amplitude modulation is QAM-16, QAM-64 or QAM-256.
- 20 6. A method of receiving data packets accommodated in video lines of a television signal, comprising the step of quadrature amplitude-demodulating (61) said data packets.
7. An arrangement for transmitting data packets in video lines of a television signal, characterized in that the arrangement comprises a quadrature amplitude modulator (14)  
25 for quadrature amplitude-modulating each data packet, using a predetermined carrier frequency ( $f_c$ ) which is located within the baseband video bandwidth of said television signal, and means (15) for inserting said quadrature amplitude-modulated data packet in selected video lines of the television signal which are not used for video signal transmission.

8. An arrangement for receiving data packets accommodated in video lines of a television signal, comprising a quadrature amplitude demodulator (61) for demodulating said data packets.
- 5 9. A television signal comprising data packets in lines of the television signal which are not used for video transmission, characterized in that said data packets are quadrature amplitude-modulated, using a predetermined carrier frequency which is located within the baseband video bandwidth of said television signal.



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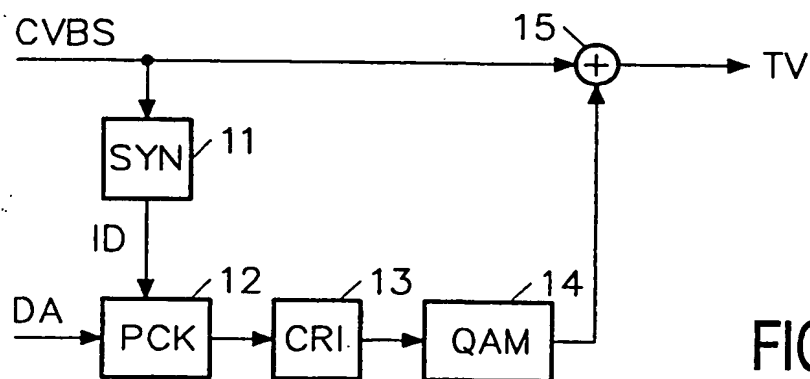


FIG. 1

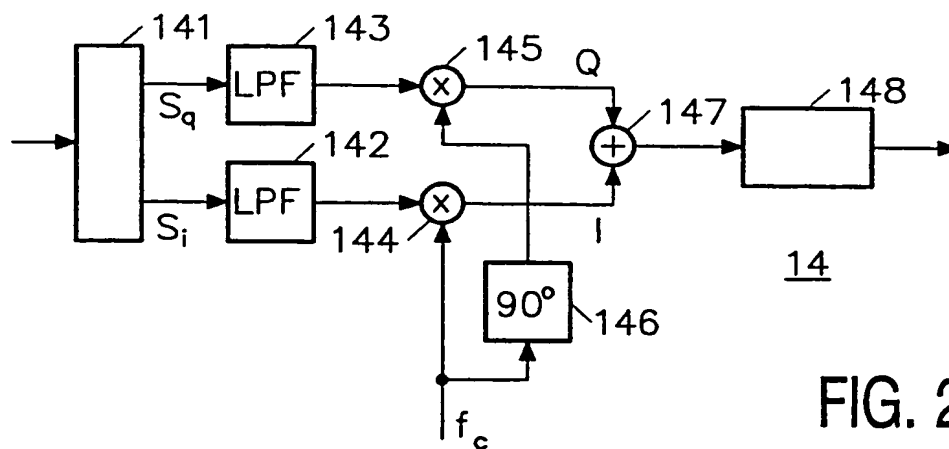


FIG. 2

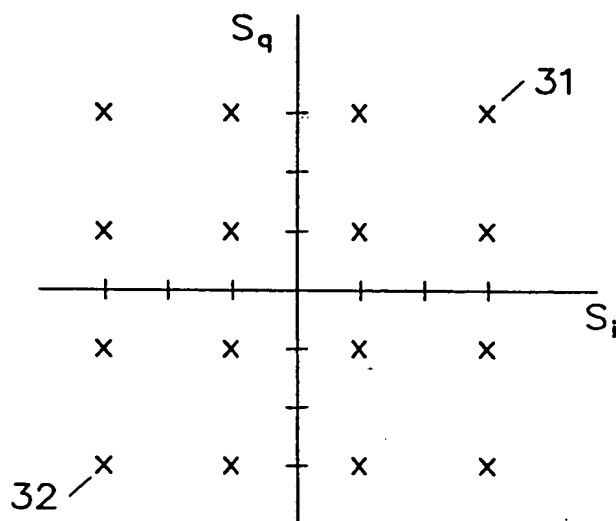


FIG. 3

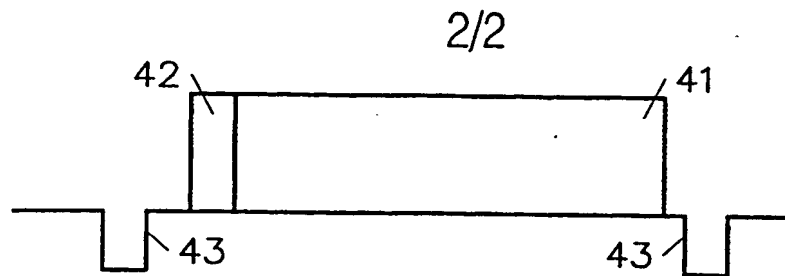


FIG. 4

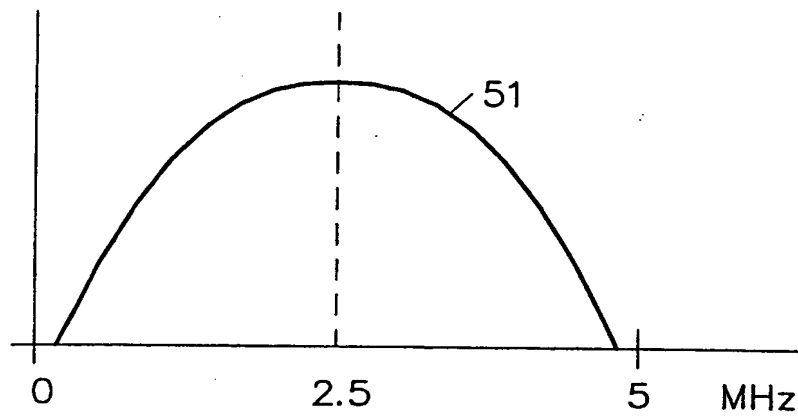


FIG. 5

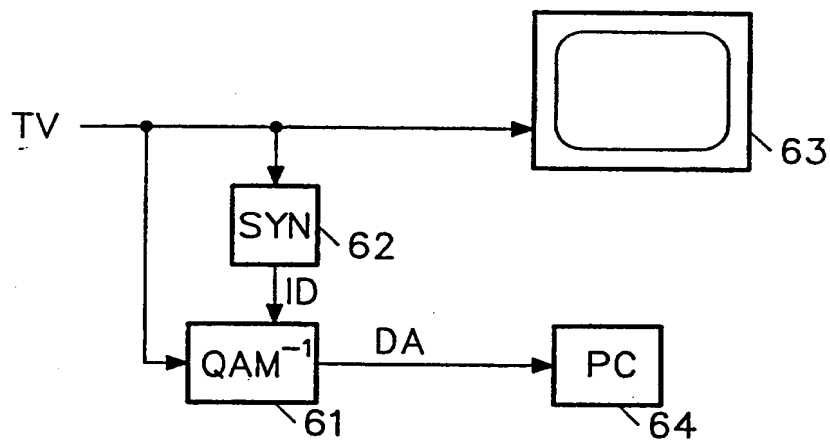


FIG. 6

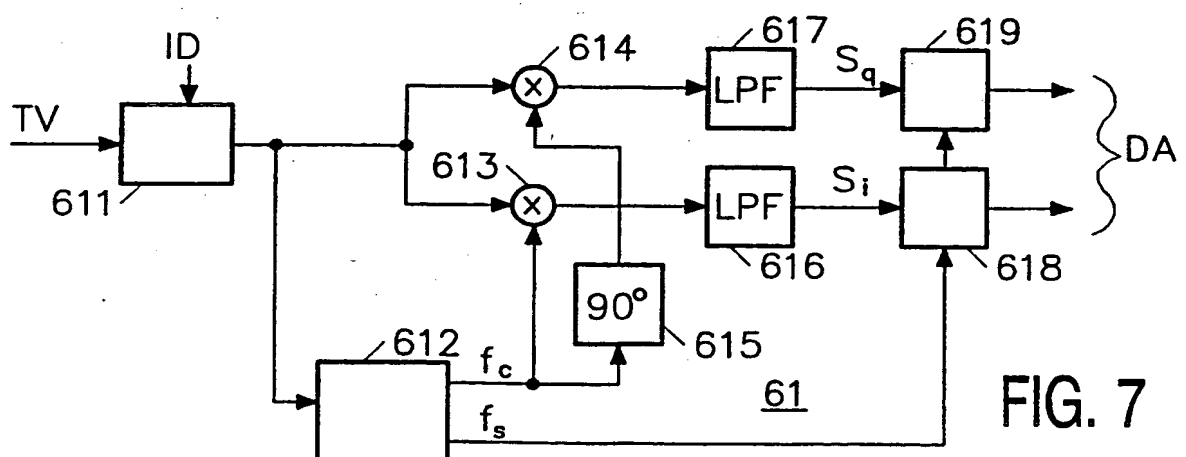


FIG. 7

# INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/EP 99/09204

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04N7/081 H04N7/088

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 195 44 582 A (DEUTSCHE TELEKOM AG) 5 June 1997 (1997-06-05)	1,2,4-9
A	page 2, line 28 - line 30 page 4, line 40 - line 60; figure 4	3
X	US 5 309 235 A (NAIMPALLY SAIPRASAD V) 3 May 1994 (1994-05-03) column 2, line 63 - column 3, line 22; figure 1 figure 4 column 5, line 53 - line 62; figure 6	1,2,4-9

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17/04/2000

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 19544582	A	05-06-1997	NONE		
<hr/>					
US 5309235	A	03-05-1994	JP	2694221 B	24-12-1997
			JP	6225341 A	12-08-1994
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